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Integer Operations Using a Whiteboard

Integrating interactive technology enhances student engagement and understanding of a common middle school topic.

Our fifth-grade social studies textbook describes technology as tools that can help the user make something or do something. Although these descriptors fit the pencil, the chalkboard, and the overhead projector, in the twenty-first century most of us think of computers, Bluetooth®, and Wi-Fi™ when we hear the word *technology*. Even so, the definition stands. These are tools that help us do something.

We are currently inundated with new technologies, such as new versions of graphing calculators, wireless headsets, and digital books, to name a few. In addition, a quick search on the Internet can result in directions for creating a multipoint interactive whiteboard out of video game parts.

In the midst of all these bells and whistles, it can be easy to lose sight of the true purpose of technology. These tools were designed to help with instruction. They should not be the centerpiece of the classroom. Un-

fortunately, simply having a piece of technology is not enough to increase student learning. As stated by NCTM in its 2008 Position Paper on technology: If we want students to benefit from the technology we are using, it has to be strategically integrated into instruction. We have to use it consistently, and we have to use it well.

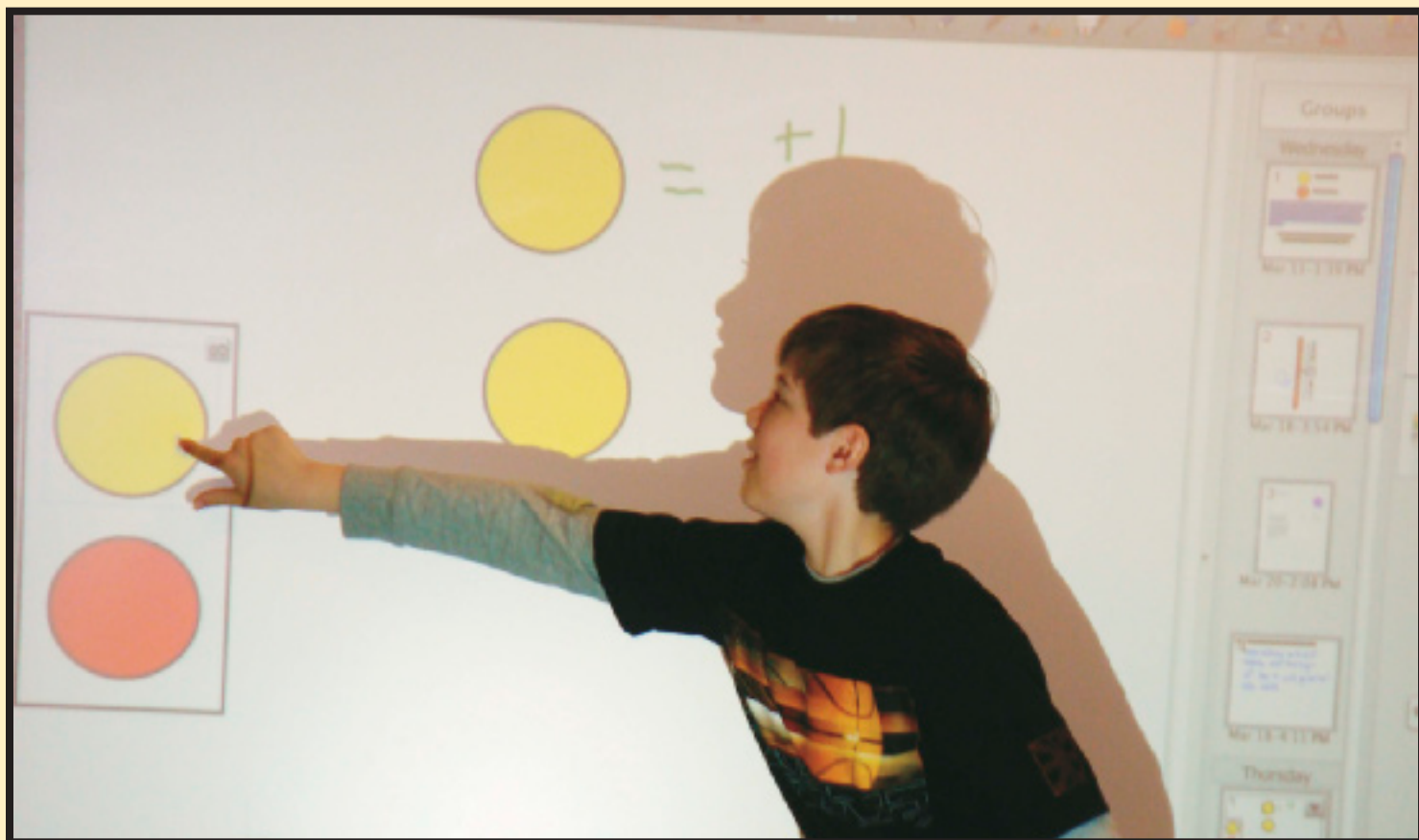
I began using an interactive whiteboard in my classroom a few years ago. Adapting to the new tool challenged me to improve my practice as a teacher. Getting to the point of using the board consistently and using it well was not as easy as I expected it to be, but I have made some exciting discoveries and learned some important lessons in the process.

WHAT IS SO SPECIAL ABOUT INTERACTIVE WHITEBOARDS?

Interactive whiteboards are somewhat unimpressive at first and look like the whiteboards that already hang on

the walls of many classrooms. There are, however, many ways that this technology can enhance mathematics instruction.

One powerful feature of interactive whiteboard technology is the ability to manipulate graphics. Any line, shape, clip-art image, or photograph can be moved across the screen, rotated about its center, and scaled up or down. For a lesson on measuring angles, a protractor can be used to measure an angle that matches the students' lesson materials. Although this action can be completed using an overhead projector, the advantage of the interactive whiteboard is the ability to scale the image. The teacher can zoom in on various parts of the image and demonstrate proper placement of the protractor. Likewise, for a lesson on transformations, images can be easily manipulated during a discussion, without a lot of unnecessary copying and tracing.



The ability to repeatedly clone an image is another feature of interactive whiteboards. An original image can be locked in place so that each time the image is touched, a new copy is created. This feature can be used to create manipulatives, such as base-ten blocks or two-color counters, for building models of numbers.

As students work with manipulatives, the teacher can model strategies at the board by dragging the appropriate images into the workspace. The limitless supply and ease of working with clip-art images of manipulatives, as opposed to overhead or magnetic models, gives the interactive whiteboard a clear advantage.

Interactive whiteboard technology also allows teacher- or student-created material to be reviewed during a lesson. This review can occur in several ways. When the board is filled with math work, the user does not need to erase it to generate a clean workspace, as is necessary with a traditional white-

board. This technology allows the user to save pages of work as in a word processing document. As new pages are added, the work on the previous pages can be accessed by simply moving back through the document. This gives the teacher the ability to locate specific elements of lesson material quickly to help students make connections, recall strategies, and find common errors.

A variety of mathematical activities can also be recorded on interactive whiteboards. Entire lessons can be recorded and posted on a Web site for students who missed the lesson or need additional review. Individual problems or processes can be reviewed and played back for a class to analyze and discuss. When teachers must miss class, they can prerecord material for a substitute. Students can also record work and explanations for an assessment.

These are just a few of the many features that interactive whiteboard technology can bring to a mathematics

classroom. As with most new technologies, the more it becomes a part of the environment, the more ways that teachers will discover they can use it to enhance instruction and learning.

LESSON EXAMPLE

I used an interactive whiteboard while working with a group of fifth-grade students exploring how to add and subtract integers. Using this technology with this lesson enhanced student understanding of the mathematical objectives in many ways. Students also used a mobile laptop lab to practice solving integer subtraction problems using the chip model found on the National Library of Virtual Manipulatives (NLVM) Web site. This site increased their engagement and also provided a check of students' work with the physical manipulatives they had been using. The interactive whiteboard was used to model activities, record math work, and demonstrate use of the Web site.

Students used red and yellow counters to model positive and negative integers. The unit began with a teacher-created activity sheet (shown in **fig. 1**). Each student was given a plastic baggie containing a distinct number of either red or yellow counters, which they sketched on their activity sheet and then compared with the other numbers of counters at their table. After practice in naming numbers and modeling numbers in various ways (for example, -2 might be modeled with two red counters or with one yellow and three red coun-

ters), the *charge model of addition* was introduced. With this model, each addend was modeled with either yellow counters (representing positive units) or red counters (representing negative units). The models of the two addends were then combined, and zero pairs were eliminated to determine the sum. The cloning feature of the whiteboard was used during this part of the lesson, so students were able to drag copies of yellow or red counters into the workspace to model problems. Each example was saved so that it could be referred to as needed. With

a limited supply of magnetic counters and marker board space required for modeling multiple cases, saving examples using traditional manipulatives would have been problematic.

After students became confident solving addition problems using the charge model, they categorized the problems we had solved into four groups:

1. Positive plus positive,
2. Positive plus negative,
3. Negative plus positive, and
4. Negative plus negative.

These categories were organized into two groups, based on the second addend. We looked at the case of adding a positive to any integer compared with the case of adding a negative to any integer. For each of these cases, we solved a set of problems using the charge model and then drew the solution on a number line.

After completing the problems, the whiteboard was adjusted to a dual-page display so that both sets of problems could be viewed side by side. Students quickly determined several things: Regardless of what the first addend had been, when a positive integer was added, the value increased; when a negative integer was added, the value decreased. Because these pages represented addition, the pages were shaded in green and then saved for later review.

After students had learned subtraction with the charge model, the same features of the interactive whiteboard were used to help them make connections between addition and subtraction. We looked first at subtracting a positive and then repeated the problems with a negative subtrahend. By rearranging page orders and using the dual page display on the whiteboard, we were able to compare first the two subtraction pages and then compare each addition page with each subtrac-

Fig. 1 An activity sheet explored modeling positive and negative integers.

Representing Integers

Name _____

Draw a quick sketch of your counters.

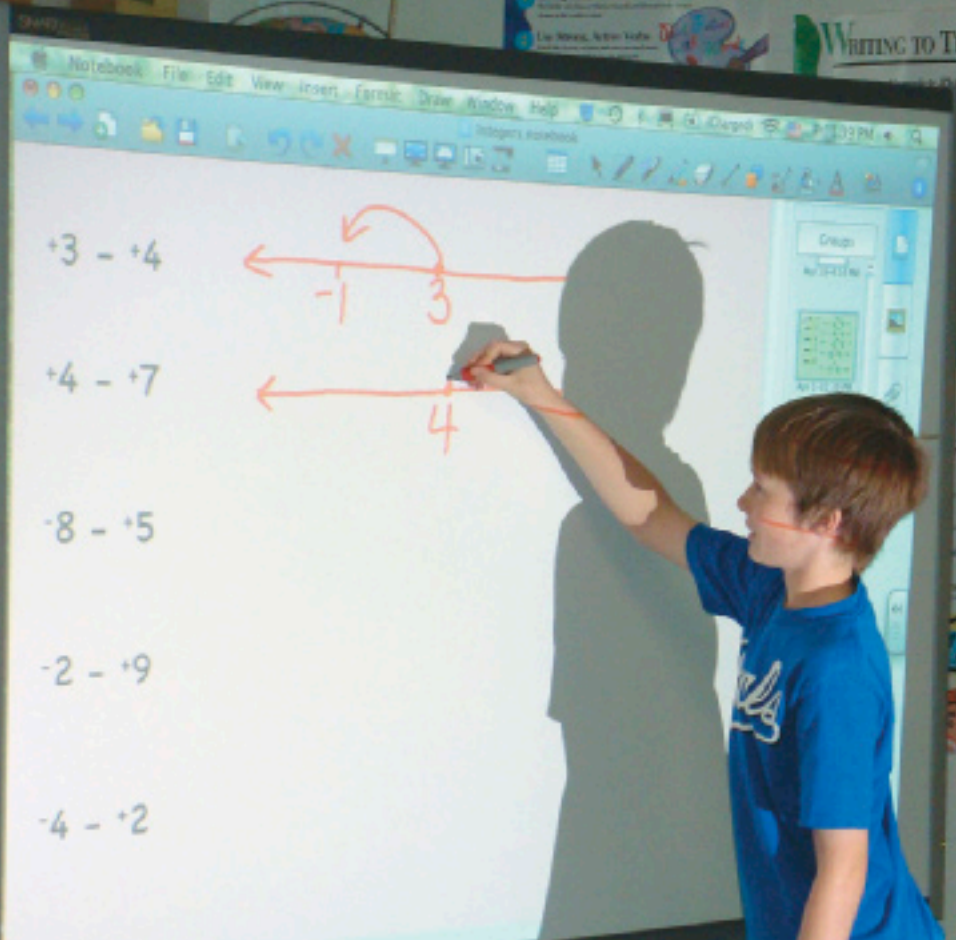
Write
the number
that represents
the value shown
by the
counters.

Write the names of everyone else in your group and the numbers that represent the values shown by their counters.

Use the lines below to write a sentence comparing the value of your counters to the value shown by another student from your group. Use a comparing phrase (*more than, less than, equal to, greatest amount, least amount*) in your sentence.

Names	Value of Counters

The inverse relationship between the operations could be clearly illustrated using various whiteboard features.



tion page. Students were able to see the inverse relationship between the operations clearly.

WHAT HAVE I LEARNED?

Although the integer unit could be accomplished without the use of technology, it was certainly enhanced by these tools. I firmly believe that we would not have been successful, however, were it not for—

- detailed planning,
- careful scaffolding during the lesson,
- active student participation,
- high-level math talk, and
- reflective thinking.

This unit demonstrates the many lessons I have learned about using technology in math class.

Lesson 1: Consistent Use Is Important

When an interactive whiteboard was first delivered to my classroom, the students were enamored with it. They wanted to touch and play with this

Technology is an essential tool for learning mathematics in the 21st century, and all schools must ensure that all their students have access to technology. Effective teachers maximize the potential of technology to develop students' understanding, stimulate their interest, and increase their proficiency in mathematics. When technology is used strategically, it can provide access to mathematics for all students. (NCTM 2008)

new toy that was the center of attention. I was nearly as excited and was sure that my lessons would be instantly transformed with this new technology. I could not wait to see it happen. The more we interacted with it, the less unusual and new it was. One day I realized that students did not see the board anymore, because their attention was on the work they were doing. It had become just another tool they could use to think, learn, and communicate about math. "When technological tools are available, students can focus on decision making, reflection, reasoning, and problem solving" (NCTM 2000, p. 24).

Lesson 2: The Math Is the Objective, Not the Activity

Once I began to consistently use the board in my lessons, I began to see interactive Web sites everywhere. I easily got lost researching Internet sources for activities with interactive features. It took me a while to realize that all those activities did not seem to make a difference to my students. When it comes to mathematical tasks,



Although the resources of the National Library of Virtual Manipulatives were available, some students preferred using physical manipulatives or counters.

purpose is paramount. We must carefully select worthwhile tasks not for their entertainment value but for how well they help the teacher facilitate the learning of a math objective. Although games may initially engage students, the excitement is often difficult to sustain, and games certainly could not give the whole class an opportunity to interact with the mathematical ideas I wanted them to learn, understand, and remember. They did not further the mathematical goals for the class.

High-quality lessons need to be planned with mathematical objectives in mind, not with the goal of working in some fun activity. This idea is fundamental to the way I plan my lessons. Instead of looking for a way to fit some math into a new feature I just learned, I use the interactive features of the board if and when they support and enhance the mathematics in the lesson.

The use of the cloning feature during our integer lesson is a good example of this idea. The small action of instantly and repeatedly duplicat-

ing an image with ease represents the power of this type of technology. When this feature was used, it was not flashy, and there were no sound effects. There was, however, access to an unlimited supply of manipulatives so that students could share, discuss, save, and later refer to examples of their work.

Lesson 3: Don't Knock the Old-Fashioned Methods

The National Library of Virtual Manipulatives Web site is one of my favorites. I use manipulatives in my mathematics lessons frequently and found this site to be helpful when demonstrating and building connections during instruction.

During the integer lesson, students had used physical manipulatives to review and discuss ordering and comparing integers and then to develop the concept of adding integers. In the next phase of the lesson, students used laptop computers to access the NLVM and explore integer subtraction problems together on the site. Although

most students were thrilled to be able to use the computer to practice, some still chose to use physical manipulatives. A few students completed the problem using both methods.

For some of the students, the program on the site was more helpful than the counters because it gave them prompts and told them if they found the correct answer. For others, using the physical manipulatives was important, because they actually needed to manipulate the chips.

PUTTING IT ALL TOGETHER

Careful and intentional use of new technologies, such as the interactive whiteboard, can improve student learning. As teachers endeavor to include these technologies in the classroom, they will need to rely even more on the consistent use of best practices in instruction. To accommodate the learning curve that is required with new technologies, teachers will be required to think carefully through an entire lesson as they plan.

To enhance students' understanding of mathematical concepts, highly effective teachers think carefully about what students might think, say, and do during a lesson. This practice enables the teacher to effectively guide students from their current understanding to comprehension of new ideas or concepts. To be prepared for unexpected glitches with the technology, teachers must also think more about which learning modalities and alternate strategies could help students access new learning.

I am reminded that although a wide range of technology is available, what matters most is instruction. As Schmoker (2006, p. 9) has argued: "Teaching has 6 to 10 times as much impact on achievement as all other factors combined." "Effective use of technology in the mathematics classroom depends upon the teacher"

(NCTM 2000, p. 25). Technology is the tool. It helps us *do* something. If used well, technology can truly enhance quality instruction.

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I ♥ Fibonacci numbers.

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